

Listening: Making Sense of the Sonic Soup

Front-end Evaluation

Adam Klinger and Sue Allen

Exploratorium, 2005

Made possible through the generous support of



This material is based upon work supported by the National Science Foundation under grant Number 0307925. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation

Listening: Making Sense of the Sonic Soup Front-end Evaluation

2005

Adam Klinger and Sue Allen

Table of Contents

Executive Summary	3
Introduction	5
Goals.....	5
Methods.....	6
Interview structure	6
Visitor selection and interview location.....	6
Interview dates.....	6
Coding	6
Conventions	7
Demographic data	7
Findings.....	8
Associations with and definitions of “listening”	8
Pre-existing listening activities and behaviors.....	10
Listening motivators	12
Obstacles to listening and ways to overcome them.....	19
Pre-existing beliefs about learning to listen	22
Stories about listening.....	24
Listening to ambient noise.....	29
Listening despite ambient noise.....	31
Recommendations	32
Acknowledgements	33
Appendix A: Interview A Instrument	34
Appendix B: Interview B Instrument	36

Executive Summary

This report describes a front-end evaluation study conducted by in-house Exploratorium staff for an NSF-funded exhibition-development project called *Listening: Making Sense of the Sonic Soup*.

During a series of weekends and weekday afternoons in 2004 we conducted interviews with 152 visitors aged 10 and older. The overall purpose was to find out what visitors already knew, did, and believed in relation to the topic of “listening,” and to test some of the project team’s assumptions about potential exhibit ideas.

Key findings from the study were:

- The majority of visitors defined “listening” in a similar way to the project team: As distinct from “hearing,” listening involves paying attention, a desire for comprehension, or both.
- Visitors associated listening with two main sources: human speech and music. These were the sounds most visitors said they already listen to, as well as the things they would most like to develop even more skills in listening to.
- In addition to speech and music, many visitors also suggested having exhibits that incorporate quiet or natural sounds, and dark environments with headphones.
- Visitors were especially interested in new sounds, nuances of sound, and the meanings behind sounds. Elsewhere in their lives they had been motivated to listen attentively by a need to act on, learn, or diagnose something important. Listening had also been motivated by emotions such as fear, curiosity, and delight.
- Many visitors told powerful stories about previous listening experiences.
- Visitors believed listening is a learnable skill, and suggested that it be made joyful and intellectually engaging for children.
- Visitors felt the main obstacles to listening were other noises or mental distractions, and that they overcame these by using tools (such as closing eyes or using headphones) or having strong desire to attend in spite of distractions.
- In a test of a simple listening activity, visitors were able to focus on specific sounds well enough to make fine discriminations, despite the museum’s high

level of ambient sound.

- Visitors were readily engaged in listening attentively to the museum's ambient sound itself.

Implications of these results are discussed in the section on Recommendations.

Introduction

This front-end evaluation was conducted as part of an NSF-funded project called *Listening: Making sense of the Sonic Soup*.

Goals

The project's overall goals are to:

- Provide an engaging environment for museum visitors to recognize, explore, and understand the importance of sound, hearing, and listening;
- Create experiences where visitors listen in order to learn scientific content;
- Integrate exhibit development, mediated activities, designed environments, visitor research and public programming;
- Give visitors the opportunity to explore the scientific, physiological, and cultural content of sound, to listen attentively and develop discriminatory listening skills, to learn about scientific research and artistic creations related to sound / hearing / listening, and to recognize the impact of ambient sound on health and environment;
- Create a collection of new exhibits installed among the current sound and hearing exhibits;
- Create a specially designed environment conducive to attentive listening.

Research questions

The project team is attempting to learn from available information related to prior exhibitions and studies in this topic area. Because much of the previous work (e.g., exhibitions such as *Dangerous Decibels* at OMSI, or *Hear Here* at the Montshire Museum of Science) has emphasized sound and hearing, this in-house study focused more on the Listening aspect of the project, and the challenges of creating an attentive listening area on the museum's noisy public floor.

- Do visitors share the team's view of listening as an active process, requiring deliberate attention and understanding, not just auditory reception?
- What kinds of listening practices do visitors already engage in?
- What might encourage visitors to undertake the effortful activity of attentive listening?
- What do visitors consider as obstacles to attentive listening in their lives?
- Do visitors believe that listening is a learnable skill?
- Do visitors have memories of powerful listening experiences in their lives?

- Does the museum’s ambient noise have potential to engage visitors in attentive listening?
- Can visitors listen attentively to something other than the museum’s high levels of ambient noise?

Methods

Interview structure

Due to the depth and number of questions, we decided to split the interview into two versions, each with different questions and conducted with different visitor groups. Interview A consisted of 6 multi-part questions and an optional ambient sound listening exercise. Interview B consisted of 6 multi-part questions and two optional listening activities, in which visitors were asked to compare an open-ended listening experience to a more focused experience with a specific goal. An interview (either A or B) took approximately 10-20 minutes to complete. The full list of questions from both interviews is given in Appendix A and B.

Visitor selection and interview location

We interviewed randomly selected individual visitors aged 10 and older, who were visiting the museum alone or as part of a family group. Visitors were recruited and interviewed in one of two locations: on the mezzanine bridge between the existing Sound and Hearing and Electricity sections, or on the main floor of the museum, underneath the “swirl” window just outside the store. Locations and interview versions were alternated after every visitor, in the following order:

Downstairs-A, Downstairs-B, Mezzanine-A, Mezzanine-B

Interview dates

Interviews were conducted on weekdays between 1pm and 4pm, and on weekends between 10am and 4pm in two phases:

1/04-2/04 (50 each of interview A and interview B)

11/04-12/04 (26 each of interview A and interview B)

Coding

Interviews were coded using mostly emergent categories of answer, but within a framework that addressed the project team’s questions. Coding was done by one coder only, reflecting the nature of this study as primarily intended for an internal

audience. As visitors often gave responses that fit into more than one coding category, the response totals for some the tables below are more than 100%.

Conventions

In the “examples” columns of this report, exact visitor quotes are put in quotation marks, while paraphrased or summarized versions of visitors’ responses are listed without quotation marks.

Demographic data

Sample size

In all, 152 interviews were conducted: 76 visitors answered interview A and 76 answered interview B.

Gender distribution

Gender	Interview A (N=76)	Interview B (N=76)	Total (N=152)
Male	42 (55%)	37 (49%)	79 (52%)
Female	34 (45%)	39 (51%)	73 (48%)

Age distribution

All adult ages were estimated by the interviewer; children were asked their age.

Age	Interview A (N=76)	Interview B (N=76)	Total (N=152)
10-12*	3 (4%)	3 (4%)	6 (4%)
13-17	7 (9%)	5 (7%)	12 (8%)
18-29	18 (24%)	22(29%)	40 (26%)
30s	16 (21%)	16 (21%)	32 (21%)
40s	19 (25%)	23 (30%)	42 (28%)
50s	7 (9%)	3 (4%)	10 (7%)
60+	6 (8%)	3 (4%)	9 (6%)
adult, unknown age		1 (1%)	1 (1%)

*Children aged 10-12 are underrepresented in this sample when compared to general Exploratorium visitorship. There are two primary reason for this: a) 47 of 152 visitors (31%) were interviewed on non-holiday weekday afternoons, when few school aged children are present, and b) children in this age range were less likely to agree to a 10-20 minute interview than older children or adults.

Findings

Associations with and definitions of “listening”

Since “listening” was the primary focus of the project, we wanted to know what associations visitors already had with that term, and whether they shared the team’s interpretation of listening as a more deliberate, attentive process than hearing. To do so, we asked visitors about their associations with the word “listening” and what they thought the difference between hearing and listening was.

Question A1: Sound sources associated with “Listening”*

Category	Number of visitors (N=76)	Examples
Human Speech	45 (59%)	Talking, voices, telephone, questions, listening to my parents.
Music	22 (29%)	Music, a song, the stereo.
Manufactured objects	6 (8%)	Sounds of the city, bells, cars.
Quiet / soft sounds	5 (7%)	Quiet, whispers.
Natural sounds	4 (5%)	Animals, water.
Crying / yelling / laughter	2 (3%)	Child crying, yelling.
Bodily noises	1 (1%)	Crowd noises.
God / intuition / non-sensory sounds	1 (1%)	Listening to God.
No specific sound source mentioned	22 (29%)	“Hearing, understanding.”

**For this table and those that follow, numbers may add up to more than 100% because some visitors' responses fit into more than one coding category.*

Question A2: Differences between “Hearing” and “Listening”

Category	Number of visitors (N=76)	Examples
Listening involves greater volition, attention, or activity than hearing	40 (53%)	"Listening is active, hearing is passive." "Hearing is less intentional than listening." "With listening you can feel it and you can follow through, and hearing it comes in but you don't necessarily act. "
Listening involves greater thought or comprehension than hearing	37 (49%)	"Hearing could just be sound, and listening is like listening to what someone's talking about." "Listening is actively trying to find out something."
HEARING involves greater attention or comprehension than listening.	2 (3%)	"You're always listening, but you're not always hearing."

No difference between hearing and listening	1 (1%)	
None of the above	4 (5%)	"Listening is always a communication between two people."

Main result

More than half of visitors' definitions of "listening" were similar to those of the project team: listening involves paying attention, a desire for comprehension, or both. Also, visitors had two primary source associations with listening: human speech and music.

Implications

We should include exhibits that utilize human speech and music, as people will expect them to be represented. We should remain true to our current concept of Listening as a focused and active process.

Pre-existing listening activities and behaviors

As one of the project's major goals is to get visitors to engage in attentive listening, we wanted to know what sorts of things they normally listen to, particularly with focused attention. To do this, we asked them to list three things they hear every day, and three things they really listen to every day.

Question B14: Things heard every day

Category	Number of visitors (N=76)	Examples
Manufactured objects	66 (87%)	Alarm clock, car starting, plumbing noises.
Human speech	60 (79%)	A child's voice, voices on the radio.
Music	29 (38%)	Music from the radio or computer
Natural sounds	22 (29%)	Pet noises, running water.
Crying / yelling / laughing	10 (13%)	Children laughing or whining.
Bodily noises	8 (11%)	Footsteps, breathing, coughing.
Did not specify	1 (1%)	

Question B15: Things listened to intently every day

Category	Number of visitors (N=76)	Examples
Music	38 (50%)	Music
Human speech	36 (47%)	My teacher, talk radio
Other bodily noises	2 (3%)	"Busy noises" (from a teacher) "Body noises" (from a doctor.)
Man-made sounds (not bodily noises)	2 (3%)	The toaster popping up.
Natural sounds	2 (3%)	The ocean, birds.
God / intuition / non-sensory sounds	1(1%)	"My heart!"
Crying / yelling / laughing	1(1%)	"the crying sounds of my kid."
Nothing I listen to every day	9 (12%)	

Main result

Visitors most commonly reported hearing human speech and noises from manufactured objects (such as cars, alarm clocks, and machinery) in their daily lives, but said they choose to listen attentively to speech and music.

Implication

We can use speech and music as arenas of existing success: build on them, push on them further, and recognize that they are motivating for visitors.

Listening motivators

We expect that visitors will find it a significant challenge to listen attentively on the chaotic and noisy museum floor, so we tried to find out what they liked to listen to, sounds and situations we might be able to harness to help them listen more in our exhibition. To get at this, we asked visitors to tell us stories of times that they remembered listening intently to something, as well as questions about things they would like to listen to, listening skills they would like to learn, and suggestions for exhibits we could build. We also asked them what they believed would motivate children to listen, if anything.

Question A3: Sounds that visitors recalled listening to intently

Category	Number of visitors (N=76)	Examples
Human speech	42 (55%)	Taking verbal instructions, listening to newscast about an important event.
Music	11 (14%)	Listening to an opera singer, listening to the stereo.
Manufactured objects	8 (11%)	Engine noises, cable car, exhibit beeping.
Natural sounds	7 (9%)	Animal sounds, water sounds, wind.
Bodily noises	6 (8%)	Breathing, snoring, heartbeat
Exotic sounds	6 (8%)	Exotic animal sounds, echoes in a cave, a sonogram, a rare musical instrument.
Crying / yelling / laughter	4 (5%)	A crying baby, Yelling.
Quiet / soft sounds	2 (3%)	Quiet, dragonflies.
Sounds incongruous with environment	2 (3%)	<i>At Listening Vessels</i> , hearing a far away person's voice as if they were nearby.
God / intuition / non-sensory sounds	1 (1%)	God's voice.
None of the above	1 (1%)	"When my brother died, I don't want to talk about that."
Nothing / unsure	4 (5%)	

Question A3: Feeling or motivation behind visitor's intent listening

Category	Number of visitors (N=76)	Examples
In order to act or learn	43 (57%)	"When I had to count a large sum of money."
Love or attachment to others	23 (30%)	"When my dad told me to break up with my boyfriend."
Curiosity	14 (18%)	"I heard different bird sounds and I wanted to know where they were, and what kind of birds they were."
Noisy surroundings	13 (17%)	"People were in a conference call so we were fighting interference over the telephone lines."
Fun / excitement / neat / cool / beautiful	11 (14%)	"Because I really enjoy listening to Grover [Washington, Jr.] play his horn."
Fear / anxiety / surprise	10 (13%)	"I thought it might be an intruder."
Other emotions	2 (3%)	"Because she's annoying."
No feeling or motivation stated	6 (8%)	

Question A6: Sounds that visitors want to learn to listen to

Category	Number of visitors (N=76)	Examples
Human speech	25 (33%)	Voices. Meaning cues in voices. Learning to tell if someone is lying.
Music	13 (17%)	To have perfect pitch. To hear components of music
Manufactured objects	6 (8%)	Movie special effects. The Doppler effect.
Natural sounds	4 (5%)	To learn what dogs are saying. To learn to hear different bird songs. How sounds are different in different atmospheres.
Bodily noises	1 (1%)	To hear footsteps.
Quiet / soft sounds	1 (1%)	To listen for silence.
God / intuition / other non-sensory sounds	1 (1%)	To listen to God
Nothing / unsure	18 (24%)	

Question A6: Listening skills visitors would like to learn

Category	Number of visitors (N=76)	Examples
Detect new sounds or nuances	21 (28%)	To hear a note and know what it is. To hear how echoes sound in different kinds of rooms. To tune out all sounds but one.
Discern meaning in sounds	18 (24%)	What different animal noises mean. To understand other languages. To follow instructions.
Focus attention on listening / retain more	10 (13%)	To pay attention to my professors more. To be more/less selective in listening.
Understand other languages	6 (8%)	To learn to understand Spanish.

Question A5c: Things visitors think might motivate children to listen

Category	Number of visitors (N=75)	Examples
Academic interest or joy of learning	29 (39%)	When listening to something they're interested in. When they are interested in the topic.
Material rewards / privileges / avoiding punishment or consequences	15 (20%)	Free play time as a reward for listening. Ice cream. Punishment for not listening. So as not to look dumb for not listening.
Fun	14 (19%)	If it's fun. When playing. Because listening is entertaining.
Praise	9 (12%)	Complementing them on their efforts. If you are positive with them.
Reciprocity or modeling by others	8 (11%)	They'll listen if they're being listened to. If you teach by example.
Completion or mastery of task	8 (11%)	Listening to instructions so they can learn to play a game. If they want to be a scientist, they'll listen in science class.
Aesthetic appreciation	2 (3%)	Listening to music that they enjoy. If something pleases their ear.
None of the above	12 (16%)	

Question B13: Motivation for listening to a sound for the first time

Category	Number of visitors (N=76)	Examples
Curiosity	19 (25%)	"Was it a mammal or a bird?"
Fear/ anxiety/ surprise	18 (24%)	Animal alarm call, gunfire.
Fun / exciting / neat / cool / beautiful	14 (18%)	A rocket launch, a whale call, an elephant.
Importance of hearing in order to act or learn	2 (3%)	Picking an instrument out of a symphony for music class, listening for alarm calls.
Love or attachment to others	2 (3%)	Pet noises.
Difficult to listen or hear so greater effort to pay attention.	1 (1%)	Picking out a particular instrument at a symphony.
No specific motivation	28 (37%)	

Question B16: Suggestions for types of exhibit or experiences

Category	Number of visitors (N=77)	Examples
Quiet or dark environment / headphones	27 (35%)	A dark room, headphones, an isolation chamber.
Demonstrating perceptual / attentional / meaning-making / memory processes	16 (21%)	Learning to hear a new sound, echolocation, identifying patterns in speech or music.
Explaining properties of sound or physical mechanisms of hearing	9 (12%)	Hearing tester, physical properties of voices or music.
Isolating component(s) of sounds	9 (12%)	Breaking down music into components, picking a sound out of many.
Sounds to identify	6 (8%)	Figuring out what is making a particular noise.
Morphing sounds	6 (8%)	Changing a voice's pitch.
Allow visitors to create sounds	3 (4%)	Visitor makes music.
Compare sounds	2 (3%)	Handsets that allow visitors to hear advances in telephone sound quality.
No exhibit type suggested	13 (17%)	
Nothing / unsure	4 (5%)	

Main result

Human speech and music were the types of sound visitors wanted to learn more about. Interestingly, these were also the things they reported knowing the most about and already listening to. In addition to these categories, visitors suggested having exhibits that incorporate quiet and natural sounds, perhaps in response to the din of the Exploratorium (frequently mentioned by visitors after the ambient listening exercise), and dark environments with headphones (presumably to enhance their ability to attend). Visitors were interested in new sounds, nuances of sound, and the meanings behind sounds. For instance, their stories showed that the reasons behind their attentive listening were most often in order to know whether to take a certain action, especially in relation to a loved one. Listening was also motivated by emotions such as fear / anxiety, curiosity / surprise, or delight.

Implications

We should use speech and music as arenas where visitors might be highly motivated, especially as our environment makes listening effortful. We should attempt to include some quiet, restful and natural sounds in the collection to serve as a contrast and rejuvenation for visitors. We should remember that visitors are especially interested in attending to meaningful sounds, especially those with connections to loved ones; this is a potential pathway for bringing emotional content to the collection. We should use curiosity, surprise, and delight as motivations for listening attentively, something that we have done successfully in the past for other exhibitions. As fear and anxiety are powerful motivators, we should consider using them as well, although doing so without alienating or overly distressing a large number of visitors could be challenging.

Obstacles to listening and ways to overcome them

As already stated, we anticipate that the noisy and chaotic environment of the Exploratorium will be a particularly challenging place for visitors to listen attentively. We wanted to know if visitors agreed with us that noisy environments were hard places in which to listen, and to find out what kinds of things they already use to help them listen attentively. To assess this, we asked them what made listening hard or easy for them, and what they did when they were highly motivated to listen to something.

Question B11: What visitors believe makes listening hard

Category	Number of visitors (N=76)	Examples
Other noises	51 (67%)	"Competing sounds that are similar."
Visual distractions / distractions from other senses	23 (30%)	Flickering lights, watching my kids.
Mental distractions, including other tasks being performed	22 (29%)	Thinking about something else, Engaged in other mental activity
Lack of personal interest / intent / desire / effort	7 (9%)	"If the person I'm speaking to isn't of much interest."
Poor audibility of sound	5 (7%)	Low volume.
Physiological difficulties	3 (4%)	Hearing loss.
Unspecified distractions	1 (1%)	"Being distracted by something else."
Nothing / unsure	2 (3%)	

Question B11b: What visitors believe makes listening easy

Category	Number of visitors (N=76)	Examples
Lack of other sounds	34 (45%)	A quiet room, lack of interruptions.
Personal interest / intent / desire / effort	32 (42%)	Interesting or pleasant sounds.
Lack of visual distractions or eye contact with source	14 (18%)	Eye contact with speaker, or eyes shut.
Clarity / audibility of sound	13 (17%)	Loud or distinctive sounds.
Lack of mental distractions or other tasks performed	10 (13%)	Lack of stress, lack of other tasks.
Lack of unspecified distractions	3 (4%)	"Lack of distractions, I guess."
Nothing / unsure	1 (1%)	

Question B12: What visitors do when they want to listen to something

Category	Number of visitors (N=76)	Examples
Go somewhere quiet / reduce volume of other sounds	50 (66%)	Turn off the TV, go to a quiet room.
Intend to focus	37 (49%)	Set aside time.
Calm mind / clear mental distractions	27 (36%)	Shut out other thoughts, decide what to listen for.
Use playback device / headphones	23 (30%)	Headphones, stereo.
Close eyes / look into space	21 (28%)	Close eyes, look into space.
Look at sound source / make eye contact	19 (25%)	Look at sound source or make eye contact.
Get physically comfortable	10 (13%)	Sit in a comfy chair.
Go somewhere pleasant / familiar	9 (12%)	Go to a tranquil place, go to the bedroom.
Make sound louder	9 (12%)	Turn up volume, get closer to the person speaking, turn ear toward sound source.
Stop other activity	8 (11%)	Stop moving, stop working.
Cup hand to ear	5 (7%)	Cup hand to ear.

Main result

Not surprisingly, visitors named other noises and visual or mental distractions as the main obstacles to listening, and said that the key to overcoming them (when moving to a quieter place was not an option) was personal interest and desire. Visitors also reported having some tools at their disposal (e.g., closing eyes, using headphones, moving closer, turning toward the sound source, cupping hand to ear).

Implications

We should try to create spaces where visual clutter and distracting sounds are reduced as much as possible by creating areas that are visually and acoustically contained and utilizing sound-absorbing materials and construction techniques. Using themes and content that visitors find motivating will be crucial in helping

visitors to focus. We might also want to remind visitors about the tools they already have at their disposal, and why these work.

Pre-existing beliefs about learning to listen

We wondered whether visitors had beliefs about the process of listening that we might learn from, or (even if untrue) that might affect their willingness to try new experiences. We asked them whether they believed that people (and specifically, children) can learn to listen, and about situations that might help children to get better at listening.

Question A4: Number of visitors who believe that listening is learnable

Category	Number of visitors (N=76)	Examples
Yes	69 (91%)	
No	1 (1%)	
Maybe / sometimes	6 (8%)	
Some people can learn to listen more easily than others	6 (8%)	"I think that different people have different degrees on how much they can pay attention." "Some people are naturally able to listen better than others."

Question A5: Number of visitors who believe that listening is learnable by children

Category	Number of visitors (N=76)	Examples
Yes	59 (78%)	
No	3 (4%)	
Maybe / sometimes	14 (18%)	"I think that yes, unless it's really not interesting, then they don't listen."

Question A5b: Situations in which a child might get better at listening

Category	Number of visitors (N=75)	Examples
Listening to music	13 (17%)	Listening to music, understanding music, a song they like.
Following directions	11 (15%)	When being taught to meditate, when being taught to pay attention.
Listening to stories	9 (12%)	Story time. When someone reads to them.
Fewer sensory distractions	8 (11%)	When in a place with less distractions. When in a small group setting. When the room is calm.
In school or other supervised learning situation	8 (11%)	In the classroom, In church. When being instructed by an adult.
Immediate feedback	5 (7%)	Interaction with what they're listening to. If they get a response.
In one-on-one situations	5 (7%)	If someone were speaking to them. At the dinner table. In a small group setting.
In situations that require practice	4 (5%)	Where there is a certain routine. If they make a mistake the last time because they did not pay attention.
Listening to nature sounds	4 (5%)	Exposure to nature. When sitting outside.
When learning to sing or play music	3 (4%)	When learning a song with state names. When learning to sing.
Upon reaching a particular developmental threshold	2 (3%)	When they learn to talk. When they are at an age where they can focus better.
Other situations	5 (7%)	"in conflicts with peers or siblings."
Nothing / unsure	3 (4%)	

Main result

Fortunately, almost all visitors believe that listening can be learned. Also, the great majority of visitors think that children can learn to listen, and offered a variety of strategies for making this more likely to happen. Their main suggestion for motivating children was to make learning joyful or intellectually engaging.

Implications

We can try to teach listening skills without fear that visitors think listening is a genetic trait. We might also use some of the specific suggestions for ways to help children learn to listen (viz., using music, listening to stories, giving them practice, having them follow directions).

Stories about listening

As a possible inspiration for exhibit design, we wanted to know about powerful and memorable listening experiences that visitors had experienced in their lives. We asked them to describe in detail experiences where they were listening very intently to something or heard a sound they had never heard before.

Question A3: Sounds that visitors recall listening to intently

(Note: this table is a copy of the one under section on visitor motivations)

Category	Number of visitors (N=76)	Examples
Human speech	42 (55%)	Taking verbal instructions, listening to newscast about an important event.
Music	11 (14%)	Listening to an opera singer, listening to the stereo.
Manufactured objects	8 (11%)	Engine noises, cable car, exhibit beeping.
Natural sounds	7 (9%)	Animal sounds, water sounds, wind.
Bodily noises	6 (8%)	Breathing, snoring, heartbeat
Exotic sounds	6 (8%)	Exotic animal sounds, echoes in a cave, a sonogram, a rare musical instrument.
Crying / yelling / laughter	4 (5%)	A crying baby, Yelling.
Quiet / soft sounds	2 (3%)	Quiet, dragonflies.
Sounds incongruous with environment	2 (3%)	At <i>Listening Vessels</i> , hearing a far away person's voice as if they were nearby.
God / intuition / non-sensory sounds	1 (1%)	God's voice.
None of the above	1 (1%)	"When my brother died, I don't want to talk about that."
Nothing / unsure	4 (5%)	

Question A3: Feeling or motivation behind visitors' intent listening

(Note: this table is a copy of the one under section on visitor motivations)

Category	Number of visitors (N=76)	Examples
In order to act or learn	43 (57%)	"When I had to count a large sum of money."
Love or attachment to others	23 (30%)	"When my dad told me to break up with my boyfriend."
Curiosity	14 (18%)	"I heard different bird sounds and I wanted to know where they were, and what kind of birds they were."
Noisy surroundings	13 (17%)	"People were in a conference call so we were fighting interference over the telephone lines."
Fun / excitement / neat / cool / beautiful	11 (14%)	"Because I really enjoy listening to Grover [Washington, Jr.] play his horn."
Fear / anxiety / surprise	10 (13%)	"I thought it might be an intruder."
Other emotions	2 (3%)	"Because she's annoying."
No feeling or motivation stated	6 (8%)	

Question: B13: Sounds that visitors recall hearing for the first time

Category	Number of visitors (N=76)	Examples
Exotic sounds	33 (43%)	Peacock, glacier, car crash.
Natural sounds	32 (42%)	Animal call, the ocean, thunder.
Manufactured objects	16 (21%)	A rocket, machine noises, a cannon fire.
Sound incongruous with environment	8 (11%)	A peacock, unusual animals.
Music	7 (9%)	A new song or instrument.
Morphed Human speech	3 (4%)	Echoes, voices under water.
Bodily noises	1 (1%)	Air bubbles under water.

Quiet / soft sounds	1 (1%)	Hard to hear because it was soft.
Nothing / unsure	19 (25%)	

Question: B13: Motivation for listening to a sound for the first time

(Note: this table is a copy of the one under section on visitor motivations)

Category	Number of visitors (N=76)	Examples
Curiosity	19 (25%)	"Was it a mammal or a bird?"
Fear/ anxiety/ surprise	18 (24%)	Animal alarm call, gunfire.
Fun / exciting / neat / cool / beautiful	14 (18%)	A rocket launch, a whale call, an elephant.
Importance of hearing in order to act or learn	2 (3%)	Picking an instrument out of a symphony for music class, listening for alarm calls.
Love or attachment to others	2 (3%)	Pet noises.
Difficult to listen or hear so greater effort to pay attention.	1 (1%)	Picking out a particular instrument at a symphony.
No specific motivation	28 (37%)	

Main result

When asked for a sound they remember hearing for the first time, visitors most commonly mentioned exotic animal or natural sounds. Also common were stories of loud or unusual man-made sounds. Both of these story types often focused on sounds that were incongruous with their environment, or frightening:

"A peacock comes to mind. Is it a cat? It was a curious sound, It didn't fit in the environment. It was in the woods near a peacock farm."

"Yes. I was on a glacier and I heard the ice moving. It was kind of like a rumble and a growl, and it sounded deep. [What was it like to hear that?] Kind of scary, because you imagine there is a lot of power behind the sound, and it's uncontrollable."

"I hear [new sounds] all the time at the animal place [where visitor works]. I know there's times like when the monkeys [made a new sound] and I found out that someone was in the compound that wasn't supposed to be there. Being aware of that, I know if something's wrong."

“The one I remember vividly is an automobile hitting another automobile, and the second one I remember is a big glass container that exploded in a lab because of pressure differences. The one in the lab was the most impressive, it was a glass jar, and I was trying to make a vacuum. It was just a startling and dramatic thing.”

Asked to recall a time when they were listening intently to something, not surprisingly visitors mentioned most often human speech and music. Regardless of the sound source, visitors reported being motivated by a need to act on, learn, or diagnose something important:

“Yes, when I'm in class, or out hunting. [What else was going on at that time while hunting?] It was in the afternoon, I was listening for doves, you need to hear the flaps before you can figure out where they are. The afternoon birds were chirping, the other hunters were shooting, our dog was running through the pond. [Where were you?] Nor. Cal, in a rice field, [near a] pond. [What was happening around you?] It was pretty quiet, there were dragonflies, but that's about it. [Why were you listening so intently?] I was trying to hear the wings of the doves, because that's the best way to find them because you can't look everywhere at once. [Did you hear what you were listening for?] Yes. A specific whistle.”

To my car's engine. Because I'll know something's going to go wrong when it starts making noises I haven't heard before. [What was going on at that time?] It was about 2 hours ago. I turned the car on and listened for the noise, and I was interacting with my wife and child. I was about to back out of my driveway. [What was happening around you?] Not much. I listen to the noise, I'm talking to my wife, and I'm backing out, and the noise went away. [Why were you listening so intently?] Because I've heard the noise before, but I was listening for it this time because I wanted to hear to see if it's happening more.”

“When a doctor spoke to you about you or your family member's health. [Can you think of a particular time?] When the doctor was trying to tell me of the heart transplant of my husband. It was a quiet situation, and it was just the 3 of us. There were no phones or outside noises. We were in the doctor's office, but it was the transplant nurse telling us. We were in a conference room. There were no windows or pictures, nothing. It was a sterile situation. [Why were you listening so intently?] It was a very important trauma, and it was very important information she was giving us.”

Both questions also elicited stories about listening to music, especially new instruments or styles:

“Listening to music in the car as we were driving here today. [What else was going on?] As little as possible, just came over the Golden Gate Bridge, parked, took a break to relax. My boy was yapping away! I heard his noise, but wasn't listening. [Why were you listening so intently?] Surprise. I flipped stations for something different. Jazz, which I don't listen to at home, got my curiosity. [Hear what you were listening for?] Yeah. I wanted to relax and it created a soothing

atmosphere.”

“The drum troupe Kodo [taiko drummers from Japan.] It wasn’t so much hearing, but feeling the sound. Not just with my ears, but my whole body. Different instruments had resonance with different parts of my body.”

Implications

Once again, we should build on people's existing interest and experience in the arenas of music and speech. Also, using surprising or novel sounds may engage visitors and make their experience memorable. Lastly, exhibits that help visitors to interpret or extract information from sounds, especially to diagnose mechanical or medical problems, may be especially engaging to visitors.

Listening to ambient noise

We wondered whether we could create experiences that used the ambient sounds of the Exploratorium as a “sonic soup” to be freshly explored, rather than as an annoyance to be shut out. To determine this, we asked visitors to take part in an ambient listening exercise, where they were to close their eyes and listen to the museum sounds around them. Afterwards, we asked them what they heard, what they thought, and their impression of the experience.

Activity A (ambient listening): What visitors heard

Category	Number of visitors (N=67)	Examples
Exhibit sounds	61 (91%)	Clanking. Beeping. A bell. Wheels turning. An exhibit. A machine.
Talking voices	47 (70%)	The sound of children. People yelling. Chattering. A cacophony of voices.
White noise / hum / echos / ambient noise	36 (54%)	The underlying hum. Noise. A grey noise.
Children yelling / crying / laughing	19 (28%)	Children shouting
Footsteps or other human sounds (except voices)	18 (27%)	People moving. Footsteps. Children playing.

Activity A (ambient listening): Visitors' self-reflections on their listening

Category	Number of visitors (N=67)	Examples
Noticed new sounds or listened in a different way	28 (42%)	Heard sounds normally taken for granted. Paid more attention.
Found activity pleasant or interesting	24 (36%)	Interesting. Nice. Pleasant. Comforting.
Tried to figure out what was making a noise	20 (30%)	Thought about what was making then noises. Tried to locate the sound.
Thought about process of listening	19 (28%)	"I was marveling on the sensitivity of my ear." " One sense cut off makes your other senses more keen." "some recede into the background as others come forward."
Found activity relaxing	12 (18%)	"Nice, because I never get a moment to sit."
Thought of something related to or associated with sound heard	9 (13%)	" I was thinking that people are having fun here, and it is very busy."
Found activity unpleasant / uncomfortable / strange	7 (10%)	"I was thinking about how the noise in here bothers me, it's a bit unpleasant."
Nothing / unsure / ambiguous	7 (10%)	

Main result

Visitors were willing to try this activity and did not find it strange or annoying. They reported hearing mostly exhibit sounds and voices, but a range of other sounds as well. Almost half reported that the experience led them to listen in a different way or notice new sounds, and almost a third reported that it got them thinking about listening as a process. One third of visitors tried to figure out what was making a particular sound.

Implications

We can use ambient sound as a source of potentially interesting sounds to be explored. We can expect that visitors will be particularly engaged by experiences where they try to figure out the source of a sound.

Listening despite ambient noise

Given the volume of the Exploratorium’s “sonic soup”, we also wanted to know if visitors could focus on something other than the ambient sound, and if so, whether they were able to reason about it or make fine discriminations, and whether such an activity could be engaging. We also wanted to know what kind of vocabulary they used to talk about their listening experiences while at the museum. To explore these questions, we asked visitors to participate in and compare two listening activities. The first activity was a passive one where they were asked to listen to a sound (specifically, a stick that the interviewer dragged across the slats of a bench), describe it, and reflect on the experience. The second activity had a more focused purpose, in the sense that visitors were asked to listen to three sounds (specifically, the striking of wooden blocks of different shapes with a mallet) and try to identify the source of each.

Activity B (analytical listening): Visitors’ ability to match block shapes with sounds

Number of blocks matched correctly	Number of visitors (N=57)
All correct	22 (39%)
One correct	23 (40%)
None correct	12 (21%)

Activity B (analytical listening): Visitors' reflections on the block-shape activity

Category	Number of visitors (N=58)	Examples
More active thinking / focused with blocks, more passive / receptive / open listening with bench	39 (67%)	"I had to think more mathematically, using logic, not just experiencing something."
Preferred blocks activity	9 (16%)	"The blocks were more interesting." "I liked it better because there was a definite answer."
Preferred bench activity	5 (9%)	"The first one had less pressure and was more enjoyable."
None of the above	13 (22%)	

Main result

We found that visitors were able to focus on something over the ambient sound, and could make fine discriminations and reason, without feeling annoyed. Unsurprisingly, they reported that this activity felt more focused and active than the passive listening activity of running a drumstick along the bench. The specific activity evoked frequent associations and comparisons with other sounds, and also got visitors to reflect on nuances in the quality of the vibrations and sound produced.

Implications

This result bodes well for the kinds of experiences we plan. Despite the high levels of ambient sound, we can expect visitors to be able to focus and make fine discriminations if they are sufficiently motivated to do so. We can also invite visitors to reflect on the qualities of sounds and the implications of those qualities.

Recommendations

Based on this study, we make the following recommendations to the project team:

- The team should continue with their current characterization of Listening as a

focused and active process.

- To motivate visitors, the exhibition should include experiences where visitors explicitly interpret the meanings behind sounds, possibly including mechanical or medical diagnostic activities. It should also try to engage emotions such as curiosity, delight, and perhaps fear, which seem to motivate powerful attentive listening experiences in people's lives.
- The exhibition should include exhibits that involve human speech and music, because these are types of sound that visitors have prior experience listening attentively to, associate with the word "listening," and would like to listen to more skillfully .
- The interpretive materials can be explicit about the skills visitors can learn in the exhibition, since visitors believe that listening is a learnable skill. Useful techniques for engaging children in attentive listening could include using music or telling stories.
- Since noises and other visual and mental distractions are the main obstacles to listening that visitors perceive, the project team should try to create spaces and experiences that reduce these as much as possible. Potential solutions might include acoustically separated exhibit spaces, liberal use of sound-absorbing materials, and headphones. To the extent that ambient sound is unavoidable, the exhibition should remind visitors of their own personal listening tools, such as cupping a hand to an ear, closing eyes, turning or moving toward a source. Finally, ambient sound may itself be used as an engaging source of sound for listening activities.
- The project team should consider including an exhibit element where visitors can tell and listen to each other's personal stories, since many visitors have compelling, varied, and brief stories about their own listening experiences.

Acknowledgements

The block-shape identification activity was designed and built by Curtis.

The *Listening* project team gratefully acknowledges the support of the National Science Foundation, which funded this study and the entire project.

Appendix A: Interview A Instrument

Date: _____ Time: _____ Interview# _____ Location: _____ Interviewer:

Gender: M F

Age (if child) _____

Estimated Age (if 18 or older) : 18-29 30s 40s 50s 60+

Group Size: 1 2 3 4 5+

Group: A A+K K T

ESL: N Y Yes, fluent

Hi, my name is xxx and I work here. Would you be willing to spend a few minutes with me talking about a new exhibition we're working on?

Great, thanks. Take a seat, so you can be comfortable...

We've just started working on a new exhibition on the topic of "listening" that's going to open here 3 years from now, and I'm trying to find out a bit about how people listen in their daily lives.

So I have some specific questions for you, if that's ok:

- 1) If I say the word "listening," what kinds of associations do you have? Just anything that pops into your mind?**

- 2) Would you say there's a difference between "hearing" and "listening"?**

Note: For us, "listening" means really paying attention to some kind of sound, not just noticing it, but really focusing on it with your whole mind.

- 3) Was there a time you can remember when you were really listening intently?**

What else was going on at that time?

Where were you?

What was happening around you?

Why were you listening so intently?

Did you hear what you were listening for?

- 4) **Do you think listening is something that people can learn to do? Can you say a bit more about that?**

- 5) **Do you think children learn to listen, in the sense that they get better at listening?**
 - 5b) **Can you think of a situation where a child might get better at listening?**

 - 5c) **What kinds of things do you think might motivate children to listen?**

- 6) **Is there anything you'd be interested in learning to listen to, or listen for? Any kind of specific skill for listening that you'd be interested in learning?**

Ok, lastly I have a little activity to do. Would you like to do an activity, or do you feel done?

Activity A (ambient)

So what the activity is, is that you to close your eyes for 20 seconds, and just really listen to everything around you. And I'll keep the time for you. And at the end of the 20 seconds, I'll ask you to tell me what you heard, and what you thought about, and what it was like to listen.

So tell me: what did you hear?

What did you think about?

What was it like to listen?

Appendix B: Interview B Instrument

Date: _____ Time: _____ Interview# _____ Location: _____ Interviewer:

Gender: M F

Age (if child) _____

Estimated Age (if 18 or older) : 18-29 30s 40s 50s 60+

Group Size: 1 2 3 4 5+

Group: A A+K K T

ESL: N Y Yes, fluent

Hi, my name is xxx and I work here. Would you be willing to spend a few minutes with me talking about a new exhibition we're working on?

Great, thanks. Take a seat, so you can be comfortable...

We've just started working on a new exhibition on the topic of "listening" that's going to open here 3 years from now, and I'm trying to find out a bit about how people listen in their daily lives.

So I have some specific questions for you, if that's ok:

Note: For us, "listening" means really paying attention to some kind of sound, not just noticing it, but really focusing on it with your whole mind.

11) What makes listening hard, for you?

11b) What makes listening easy, for you?

12) When you really want to listen to something, what do you do?

12b) Is there some way you change your environment or go somewhere specific?

12c) Are there any tools or aids you use to help you listen?

12d) Is there any way you prepare yourself to listen?

13) Do you remember a moment in your life when you heard a sound you'd never heard before? Can you say a bit more about what it was like to hear that?

14) Can you think of three things you hear every day?

15) Is there anything that you really listen to every day?

16) Can you think of any kinds of exhibits or experiences that we could create for you at the museum that might slow you down and have you really listen to something?

Ok, lastly I have some little activities to do. Would you like to do an activity, or do you feel done?

Activity B (listening despite the ambient)

So what the activity is, is that you to close your eyes, and I'm going to run this drumstick across the slats of the bench, and I'd just like you to really listen to it, and then tell me what you heard, and what you thought about, and what it was like to listen.

So tell me What did you hear?
What did you think about?
What was it like to listen?

And now I'd like to do something a little different. I'd like you to listen again, but this time I'm going to hit these three different blocks with this mallet, in a random order, and I'd like you to guess which one I hit first, second, and third. Ok? (hit blocks)

Order administered:
Order guessed:
Correct?
What made you decide which sound went with which shape?

So tell me how that experience of listening was different from what you did last time, when I ran the drumstick against the slats of the bench?